Size and Shape of Small Crystals Affect Surface Chemistry and Consolidation. Rational Synthetic Methods

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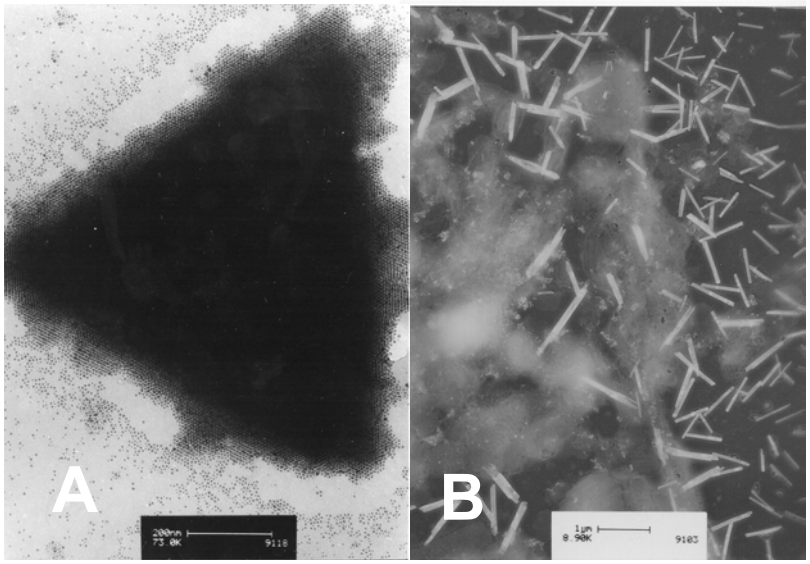
The synthesis of nanocrystals of any material is difficult to do where all the crystals are the same size and shape. However, we have discovered a chemical nanomachining process where various sized nanoparticles are converted by added surface active ligands (eg. alkyl thiols or amines) into beautifully monodisperse systems. The experimental procedure calls for synthesis of nanoparticles followed by placing them in an appropriate solvent with excess ligand, and then refluxing the solution—"digestive ripening" or "nanomachining" takes place where all the particles become the same size, and these then crystallize into beautiful nanocrystal superlattices.



A. Silver nanocrystals that are formed by "nanomachining," and which crystallize into superlattices **B**. Cadmium sulfide nanocrystals that are formed by "nanomachining," and which crystallize into superlattices

J. of American Chem. Society, **124**, 2305-2311 (2002).
J. Phys. Chem. B. (invited paper for A. Henglein Special Issue), **107**, 7441-7448 (2003).

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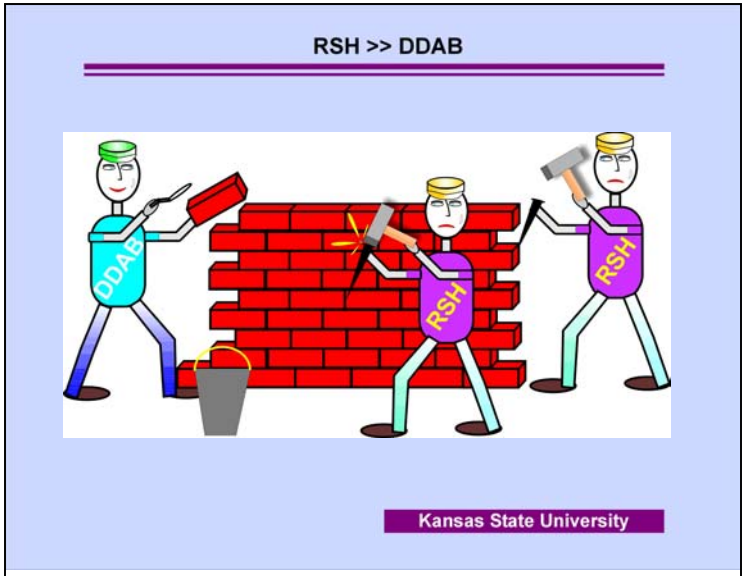
Education:

• A general lecture about the new "nanomachining" discovery has been developed. It describes how polydisperse nanoparticles are synthesized, how nanomachining by "digestive ripening" was discovered, and how large amounts of these nanocrystals are now available to produce large nanocrystal superlattices. Many spectacular electron microscope images are presented.

• This presentation also explains about nanotechnology origins, about nanoparticles as a new realm of matter, and about science fiction and nanotechnology, including a discussion of Michael Crichton's novel *Prey* and the public fear of non-stop nanoatom "men" reproducing themselves. We have presented this lecture to the University community at large (Provost Lecture), at high schools, and at junior colleges.



A cartoon approach explaining nanomachining of nanoparticles by chemically active ligands.

One undergraduate Goldwater Scholar (Peter Pauzauski), three graduate students (Savka Stoeva, Al Smetana, and David Heroux), and a postdoc (Prasad Bagavatula) have contributed to this work. Pauzauski is now in graduate school at U.C. Berkley, Smetana and Heroux are still working on their Ph.D. degrees, Stoeva graduated with a Ph.D. and is now a postdoc at Northwestern, and Prasad has a job at the National Chemical Laboratory in Pune, India.